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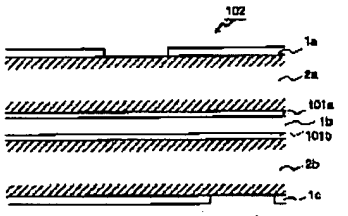
(54) PRINTED BOARD AND METHOD FOR BORING ITS HOLE WITH LASER

(57)Abstract:
PROBLEM TO BE SOLVED: To improve producibility of a conduction hole processing and realize high reliability by improvement of conductivity, by forming a metallic layer of low heat conduction and low boiling point in a conductor layer surface in the middle, at a side wherein a conduction hole for interlayer conduction is processed.
SOLUTION: In a printed board 102, zinc platings 101a, 101b are applied to both sides of a copper foil 1b which is a conductor layer held between insulation layers 2a, 2b and a metallic layer is formed. Zinc used for the zinc platings 101a, 101b is a metal of low heat conductivity and low boiling point. Therefore, when laser beam is cast on zinc to fuse zinc, a surface thereof vaporizes and an irradiation part alone can be removed. That is, zinc is vaporized during hole making processing by laser irradiation and a trouble of insulation layer residue can be eliminated by forming a metallic layer (zinc) of low heat conductivity and low boiling point in a surface of an intermediate conductor layer (copper foil 1b), by plating at a side of the printed board 102 wherein a through- hole is provided.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The printed circuit board which carries out the laminating of a conductor layer and the insulating layer by turns, and is characterized by forming the metal layer which is low-fever conduction and has a low-boiling point property in the middle conductor-layer front face of the side which processes the flow hole which makes it flow through between layers in the printed circuit board which forms a circuit pattern in the aforementioned conductor layer.
[Claim 2] The metal layer which is the aforementioned low-fever conduction and has a low-boiling point property is a printed circuit board according to claim 1 characterized by being zinc.
[Claim 3] The laser punching method of a printed circuit board of carrying out the laminating of the conductor layer and insulating layer which are characterized by providing the following by turns, carrying out spot irradiation of the laser beam near the focal position to the printed circuit board which formed the circuit pattern in the conductor layer, and breaking a microscopic small hole in the insulating layer between the middle conductor layers of the aforementioned printed circuit board. The 1st process which forms in the front face of the aforementioned conductor layer the metal layer which is low-fever conduction and has a low-boiling point property. The 2nd process which carries out spot irradiation of the laser beam which has heat energy required to evaporate the aforementioned metal layer front face, and removes the aforementioned insulating layer.
[Claim 4] The metal layer which is the aforementioned low-fever conduction and has a low-boiling point property is the laser punching method of the printed circuit board according to claim 3 characterized by being zinc.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the laser punching method of the printed circuit board which ends the very detailed flow hole (a buyer hole, through hole) which makes it flow through between layers using a laser process, and a printed circuit board in the printed circuit board of two or more layers.
[0002]
[Description of the Prior Art] Conventionally, the laminating of a conductor layer and the insulating layer is carried out by turns, and the laser punching method of a printed circuit board of breaking a very detailed flow hole in the printed circuit board in which the circuit pattern was formed is learned. The composition and its punching method of the printed circuit board in this former are explained with reference to drawing 6 and drawing 7 .
[0003] Drawing 6 is the cross section showing the laminated structure of the printed circuit board of two or more layers in the former. 1a, 1b, and 1c are copper foil as a conductor layer, and are formed by the film (10-20 micrometers). Moreover, 2a and 2b are the insulating layers which used a glass fiber strengthening epoxy resin (GARAEPO) or polyimide resin.
Insulating-layer 2a carries out the laminating of a conductor layer and the insulating layer by turns between copper foil 1a and copper foil 1b like insulating-layer 2b between copper foil 1b and copper foil 1c so that it may illustrate. Moreover, usually, before punching processing, a copper foil portion is beforehand removed to the copper foil 1a and 1c on the front face of a printed circuit board by etching processing more greatly than the diameter of punching by the laser beam (flow hole), and Holes 601a and 601b are established in it.
[0004] Next, to the printed circuit board which carried out the laminating as mentioned above, a laser beam is irradiated at a hole 601a portion, and a flow hole is processed. This processing method and a processing state are shown in drawing 7 . The hole processing portion 703 is made to condense a laser beam 701 with a lens 702, as shown in drawing 7 . Insulating-layer 2a is removed by the power intensity and the diameter of a spot of a laser beam at this time. That is, insulating-layer 2a evaporates with the heat energy of a laser beam in an instant. Consequently, hole 704a is formed like illustration. Moreover, hole 704c is formed by the same method.
[0005] By the way, the following are indicated as reference technical reference about punching processing of a printed circuit board. For example, in JP,56-144890,A and JP,58-218387,A, the low-boiling point matter is arranged on the processing section, a laser beam is irradiated by this matter, the gas which evaporates explosively is used, and eliminating the discard produced at the time of processing is indicated. Moreover, in JP,3-171610,A, using zinc as a material which will evaporate if a laser beam is irradiated (sublimation) is indicated. Furthermore, using copper foil as an electrical conducting material of a laminated circuit board is indicated by JP,6-335790,A.
[0006]
[Problem(s) to be Solved by the Invention] however, since thermal conductivity is high although copper foil 1b is a film if a Prior art as shown above is suited, heat will escape at the time of laser beam machining, and ****** 705a and 705b will remain in a hole bottom portion, without fully performing processing Since these ****** 705a and 705b were insulating layers, another processing process will need to remove and there was a trouble of checking improvement in productivity.
[0007] The result to which copper foil 1b (about 18 micrometers) carried out punching processing by laser beam irradiation to insulating-layer 2a (20-30 micrometers) as shown in drawing 8 when adding furthermore, Since ****** 705a existed in the hole bottom side even if ****** 705a with a thickness of 1-2 micrometers remained and it formed the conductor 801 with chemical plating etc. in the state with this, there was also a trouble of the ability not to make it flow through copper foil 1a and copper foil 1b.
[0008] In case this invention is made in view of the above and ends a flow hole in the printed circuit board of two or more layers, it aims at acquiring the printed circuit board which the productivity of flow hole processing in a printed circuit board is raised, and realizes high-reliability by the flow disposition top, and its laser punching method by offering the printed circuit board in which ****** does not remain, and its processing method.
[0009]
[Means for Solving the Problem] If it is in the printed circuit board concerning this invention in order to attain the above-mentioned purpose, the laminating of a conductor layer and the insulating layer is carried out by turns, and the metal layer which is low-fever conduction and has a low-boiling point property is formed in the middle conductor-layer front face of

the side which processes the flow hole which makes it flow through between layers in the printed circuit board which forms a circuit pattern in the aforementioned conductor layer.
[0010] On the front face of the middle conductor layer of the side which processes a flow hole, namely, by low-fever conduction And in case a laser beam is irradiated and a very detailed hole is processed by forming the metal layer which has a low-boiling point property, while an insulating layer evaporates in an instant The front face of the metal layer which has the above-mentioned property established between the insulating layer and conductor layer evaporates, and a printed circuit board possible [removing **** of a hole bottom portion completely] can be offered.
[0011] If it is in the printed circuit board concerning the next invention, let the metal layer which is the aforementioned low-fever conduction and has a low-boiling point property be zinc.
[0012] On the front face of the middle conductor layer of the side which processes the flow hole which makes it flow through between layers, namely, by low-fever conduction And in case a laser beam is irradiated and a very detailed hole is processed by using the zinc which has a low-boiling point property, while an insulating layer evaporates in an instant The front face of the metal layer which has the above-mentioned property established between the insulating layer and conductor layer evaporates, and it becomes possible to remove **** of a hole bottom portion completely.
[0013] If it is in the laser punching method of the printed circuit board concerning the next invention As opposed to the printed circuit board which carried out the laminating of a conductor layer and the insulating layer by turns, and formed the circuit pattern in the conductor layer In the laser punching method of a printed circuit board of carrying out spot irradiation of the laser beam near the focal position, and breaking a microscopic small hole in the insulating layer between the middle conductor layers of the aforementioned printed circuit board on the front face of the aforementioned conductor layer by low-fever conduction And spot irradiation of the 1st process which forms the metal layer which has a low-boiling point property, and the laser beam which has heat energy required to evaporate the aforementioned metal layer front face is carried out, and the 2nd process which removes the aforementioned insulating layer is included.
[0014] That is, by forming the metal layer which is low-fever conduction and has a low-boiling point property on the surface of a conductor layer, carrying out spot irradiation of the laser beam which has energy required to evaporate a metal layer front face, and removing an insulating layer, the metal layer front face of a hole bottom portion evaporates to some extent, and becomes possible [removing completely **** which was easy to produce into the portion of a bottom conventionally].
[0015] If it is in the laser punching method of the printed circuit board concerning the next invention, let the metal layer which is the aforementioned low-fever conduction and has a low-boiling point property be zinc.
[0016] On the front face of the middle conductor layer of the side which processes the flow hole which makes it flow through between layers, namely, by low-fever conduction And in case a laser beam is irradiated and a very detailed hole is processed by using the zinc which has a low-boiling point property, while an insulating layer evaporates in an instant The front face of the metal layer which has the above-mentioned property established between the insulating layer and conductor layer evaporates, and the possible processing method of removing **** of a hole bottom portion completely is realized.
[0017]
[Embodiments of the Invention] Hereafter, the gestalt of operation of the printed circuit board concerning this invention and its laser punching method is explained in detail with reference to an accompanying drawing. In addition, in each drawing of the gestalt of this operation, the same sign as the sign used by the Prior art about the same functional element as the conventional example is attached, and the explanation is omitted.
[0018] Drawing 1 is the cross section showing the laminated structure of the printed circuit board concerning the gestalt of operation. This printed circuit board 102 forms in the vertical side of copper foil 1b as a middle conductor layer the metal layer of the galvanization 101a and 101b which has low-fever conduction and a low-boiling point property, respectively to the printed circuit board shown in drawing 6 of the conventional example mentioned above. That is, galvanization 101a and 101b is given to both sides of copper foil 1b which is the conductor layer inserted into insulating layers 2a and 2b, and a metal layer is formed. In addition, although galvanization 101a and 101b was given to both sides of copper foil 1b in this example, since what is necessary is just to galvanize corresponding to a punching side if needed that is, it does not restrict to this.
[0019] While the zinc used for galvanization 101a and 101b is a good conductor, thermal conductivity especially has 97kcal/mhdegreeC, the boiling point has the property of 906 degreeC, and heat conduction is a low and typical metal with the low boiling point in a metal. Moreover, thermal conductivity has 332kcal/mhdegreeC and, as for the copper used for copper foil 1b, the boiling point has the property of 2600 degreeC. When these both thermal conductivity and the boiling point are compared, zincky thermal conductivity is about 1/3, and the boiling point 1 [about] / 3 to copper.
[0020] Therefore, if the laser beam of suitable power (heat energy) to melt zinc is irradiated at zinc, it will become possible for the front face to evaporate and to remove only an irradiation portion. That is, by forming low-fever conduction and a low-boiling point metal layer (zinc) in the middle conductor layer (copper foil 1b) front face of the side which prepares the through hole of a printed circuit board 102 by plating, zinc is evaporated at the time of punching processing by laser beam irradiation, and it becomes possible to make the fault that **** of an insulating layer remains cancel.
[0021] The example of punching processing for next establishing a buyer hole (through hole) in the printed circuit board 102 by which the laminating was carried out like above-mentioned drawing 1 is explained.
[0022] Drawing 2 is explanatory drawing showing the punching processing state concerning the gestalt of operation. Here, a printed circuit board 102 is set near the focal position of a lens 702, a laser beam 701 is condensed with a lens 702, and the case where punching processing is performed is shown.

[0023] The portion by which punching processing of the copper foil 1a of printed circuit board 102 front face is carried out is beforehand removed by etching etc. If spot irradiation of the laser beam is carried out in this state at insulating-layer 2a, since insulating-layer 2a is an epoxy resin or polyimide resin, it evaporates and becomes melting and gas 103 as shown in drawing 2 in an instant, and it will be emitted outside and the portion will serve as a hole. Although the side with galvanization 101a near copper foil 1b which is a conductor layer does not evaporate at this time, a front face serves as gas 103 and the side by which the laser beam was irradiated is emitted outside. Although **** generated in the former arises on the surface of zinc temporarily simultaneously, the base 104 of a hole is flown by zincky evaporation, and is removed completely.
[0024] Therefore, the front face of galvanization 101 evaporates and punching (buyer hole) of a printed circuit board 102 is processed in the state where it dented for a while. Since the zinc used for galvanization 101 is a good conductor, it flows through the base 104 of this hole in low electric resistance enough to copper foil 1b.
[0025] Drawing 3 is the enlarged view showing the example of hole processing in drawing 2 , and the cross section to which (a) expanded the detailed state immediately after hole processing, and (b) are the cross sections to which the state after the after treatment for a hole was expanded. As stated also in advance, if laser beam irradiation is carried out, the hole which is predetermined as shown in drawing 3 (a) will be formed in the printed circuit board 102 which carried out the laminating like drawing 1 . ****** is removed completely, a front face evaporates, and the base 104 of this hole is processed where the layer front face of galvanization 101a is dented for a while.
[0026] After performing hole processing of drawing 3 (a), a conductor 801 is formed in a part for the hole of copper foil 1a and galvanization 101a with chemical plating etc. It can be made to flow through copper foil 1a and copper foil 1b which are a conductor layer by this completely through galvanization 101a.
[0027] The example which forms the multilayer printed circuit board which next carried out the laminating of a conductor layer / galvanization and a middle conductor layer / the insulating layer based on the same procedure as the above-mentioned, and forms a buyer hole in the printed circuit board is explained.
[0028] Drawing 4 is the cross section showing the example of buyer hole formation of the multilayer printed board concerning the gestalt of operation (1). As shown in drawing 4 , as a printed circuit board first in the lower layer of conductor-layer 1a which is the 1st conductor layer Insulating-layer 2a, The laminating of the galvanization 101a is carried out between insulating-layer 2a and copper foil 1b which is the 2nd conductor layer. The laminating of the galvanization 101c is carried out to the lower layer of conductor-layer 1b between insulating-layer 2b, insulating-layer 2b, and copper foil 1c that is the 3rd conductor layer, and the laminating of 101d of the galvanization is carried out to insulating-layer 2c between 1d of copper foil which is the 4th conductor layer. In addition, insulating-layer 2a consists of a glass fiber strengthening epoxy resin layer (GARAEPO layer) or a polyimide layer.
[0029] Next, when forming the hole 401 which flows through copper foil 1a and copper foil 1c, like the above-mentioned, spot irradiation of the laser beam is carried out to the front face of galvanization 101c of the 2nd layer, and hole processing is performed. Moreover, when forming the hole 402 which flows through copper foil 1a and 1d of copper foil, similarly, spot irradiation of the laser beam is carried out to the front face of 101d of galvanization of the 3rd layer, and hole processing is performed. Then, a conductor 801 is formed in the surface portions of copper foil 1a and galvanization 101c, and the surface portions of copper foil 1a and 101d of galvanization with chemical plating etc., and it is made to flow completely to each holes 401 and 402.
[0030] Drawing 5 is the cross section showing the example of buyer hole formation of the multilayer printed board concerning the gestalt of operation (2), and shows the 2nd layer and 3rd layer about the example which forms three layers of through holes simultaneously in one buyer hole. First, the printed circuit board which consists of the 1st conductor layer - the 4th conductor layer is formed like drawing 4 . Then, a larger hole is usually broken in insulating-layer 2a, and drilling is performed to the 2nd time to the copper foil 1c surface portion which is the 3rd conductor layer by extracting the beam diameter of a laser beam further and carrying out optical irradiation from the time of hole processing of insulating-layer 2a, to insulating-layer 2b. Furthermore, in order to make the flow of a punching portion perfect, a conductor 801 is formed in a galvanization 101c surface portion with chemical plating etc. from a copper foil 1a edge. Thereby, a hole (buyer hole) 501 is obtained.
[0031] Moreover, as other methods of replacing with the above-mentioned punching processing method, the hole of copper foil 1b of the 2nd conductor-layer eye is made smaller than the 1st conductor-layer eye, and a buyer hole may be formed by one laser beam irradiation. By using this method, it can become possible to carry out like the case where the number of simultaneous drilling of a multilayer printed circuit board is one, and processability can improve, and floor to floor time can be shortened. Furthermore, the hole of the copper foil of two or more layers is made small as it becomes a lower layer, and it is also possible to perform drilling for two or more of the layers easily by one laser beam irradiation.
[0032] Here, the gestalt of implementation of this invention described above is summarized. When irradiating a laser beam at a printed circuit board and performing hole processing, the zinc which is low-fever conduction of the front face of the copper foil which is a conductor layer by the side of laser beam irradiation, and is a low-boiling point metal is first formed by plating, and the laser beam of a predetermined power intensity and diameter of a spot is irradiated there. Since it evaporates by this laser radiation since zinc itself is its low-fever conduction and low-boiling point, and **** of an insulating layer is blown away, it is lost that **** remains in the bottom of a hole.
[0033] Moreover, since zinc has the property of a good conductor, the copper foil which is a conductor layer, and a perfect flow can be taken. Therefore, since conductivity is secured while processing efficiency improves, since a troublesome

processing process becomes unnecessary in the former of removing ****** after punching by laser beam irradiation, the outstanding effect that a reliable buyer hole (through hole) can be formed is acquired.

[0034]

[Effect of the Invention] As explained above, according to the printed circuit board concerning this invention, on the front face of the middle conductor layer of the side which processes a flow hole by low-fever conduction And in case a laser beam is irradiated and a very detailed hole is processed in the process which processes the next flow hole by forming the metal layer which has a low-boiling point property, while an insulating layer evaporates in an instant Since the front face of the metal layer which has the above-mentioned property established between the insulating layer and conductor layer evaporates and **** of a hole bottom portion can be removed completely, Since the metal layer which another process for removing **** becomes unnecessary, and whose productivity improves, and does not have **** has flowed completely in the middle conductor layer, good conductivity is obtained, and reliability improves.

[0035] According to the printed circuit board concerning the next invention, on the front face of the middle conductor layer of the side which processes the flow hole which makes it flow through between layers by low-fever conduction And in case a laser beam is irradiated and a very detailed hole is processed by using the zinc which has a low-boiling point property, while an insulating layer evaporates in an instant, the front face of the metal layer which has the above-mentioned property established between the insulating layer and conductor layer evaporates, and **** of a hole bottom portion can be removed completely.

[0036] According to the laser punching method of the printed circuit board concerning the next invention, on the surface of a conductor layer by low-fever conduction And by forming the metal layer which has a low-boiling point property, carrying out spot irradiation of the laser beam which has energy required to evaporate a metal layer front face, and removing an insulating layer Since **** which the metal layer front face of a hole bottom portion evaporates to some extent, and tended to produce into the portion of a bottom conventionally can be removed completely, Since the metal layer which another process for removing **** becomes unnecessary, and whose productivity improves, and does not have **** has flowed completely in the middle conductor layer, good conductivity is obtained, and reliability improves.

[0037] According to the laser punching method of the printed circuit board concerning the next invention, on the front face of the middle conductor layer of the side which processes the flow hole which makes it flow through between layers by low-fever conduction And in case a laser beam is irradiated and a very detailed hole is processed by using the zinc which has a low-boiling point property, while an insulating layer evaporates in an instant The front face of the metal layer which has the above-mentioned property established between the insulating layer and conductor layer evaporates, and the possible processing method of removing **** of a hole bottom portion completely is realized.

[Translation done.]

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ABSTRACT:

PROBLEM TO BE SOLVED: To improve producibility of a conduction hole processing and realize high reliability by improvement of conductivity, by forming a metallic layer of low heat conduction and low boiling point in a conductor layer surface in the middle, at a side wherein a conduction hole for interlayer conduction is processed.

SOLUTION: In a printed board 102, zinc platings 101a, 101b are applied to

both sides of a copper foil 1b which is a conductor layer held between
insulation layers 2a, 2b and a metallic layer is formed. Zinc used for the
zinc platings 101a, 101b is a metal of low heat conductivity and low boiling
point. Therefore, when laser beam is cast on zinc to fuse zinc, a surface
thereof vaporizes and an irradiation part alone can be removed. That is, zinc
is vaporized during hole making processing by laser irradiation and a trouble
of insulation layer residue can be eliminated by forming a metallic layer
(zinc) of low heat conductivity and low boiling point in a surface of an
intermediate conductor layer (copper foil 1b), by plating at a side of the
printed board 102 wherein a through- hole is provided.

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審査請求　未請求　請求項の数４　ＯＬ　（全７頁）　最終頁に続く

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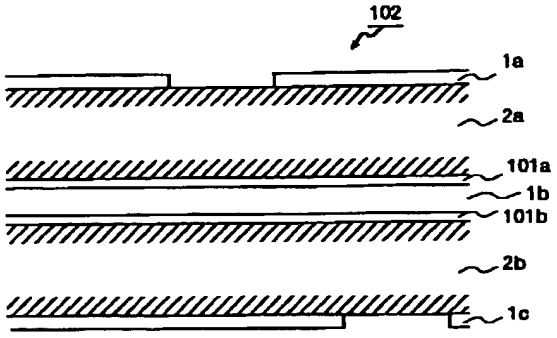
(54)【発明の名称】　プリント基板およびそのレーザ穴あけ方法

(57)【要約】

【課題】　複数層のプリント基板に導通穴を明ける際に、残渣層が残らないプリント基板およびその加工方法を提供することにより、プリント基板における導通穴加工の生産性を向上させ、かつ導通性向上による高信頼性を実現すること。

【解決手段】　銅箔１（導体層）と絶縁層２とを交互に積層し、銅箔１に回路パターンを形成するプリント基板において、層間を導通させる導通穴を加工する側の中間の銅箔１ｂ表面に、低熱伝導で、かつ、低沸点の特性を有する亜鉛メッキ１０１ａ、１０１ｂを形成する。



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【特許請求の範囲】

【請求項1】　導体層と絶縁層とを交互に積層し、前記導体層に回路パターンを形成するプリント基板において、

層間を導通させる導通穴を加工する側の中間の導体層表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成することを特徴とするプリント基板。

【請求項2】　前記低熱伝導で、かつ、低沸点の特性を有する金属層は、亜鉛であることを特徴とする請求項1に記載のプリント基板。

【請求項3】　導体層と絶縁層とを交互に積層し、導体層に回路パターンを形成したプリント基板に対し、レーザ光を焦点位置近傍でスポット照射し、前記プリント基板の中間の導体層との間の絶縁層に極微細穴を明けるプリント基板のレーザ穴あけ方法において、

前記導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成する第1の工程と、

前記金属層表面を蒸発させるのに必要な熱エネルギーを有するレーザ光をスポット照射し、前記絶縁層を取り除く第2の工程と、

を含むことを特徴とするプリント基板のレーザ穴あけ方法。

【請求項4】　前記低熱伝導で、かつ、低沸点の特性を有する金属層は、亜鉛であることを特徴とする請求項3に記載のプリント基板のレーザ穴あけ方法。

【発明の詳細な説明】

【0001】

【発明が属する技術分野】この発明は、複数層のプリント基板において、層間を導通させる極微細な導通穴（バイヤホール、スルーホール）をレーザ加工法を用いて明けるプリント基板およびプリント基板のレーザ穴あけ方法に関する。

【0002】

【従来の技術】従来、導体層と絶縁層とを交互に積層し、回路パターンを形成したプリント基板に極微細な導通穴を明けるプリント基板のレーザ穴あけ方法が知られている。この従来におけるプリント基板の構成およびその穴あけ方法について図6および図7を参照して説明する。

【0003】図6は、従来における複数層のプリント基板の積層構造を示す断面図である。1a、1b、1cは導体層としての銅箔であり、薄い層（10～20μm）で形成される。また、2a、2bはガラス繊維強化エポキシ樹脂（ガラエポ）あるいはポリイミド樹脂を用いた絶縁層である。図示するように、銅箔1aと銅箔1bとの間に絶縁層2aが、銅箔1bと銅箔1cとの間に絶縁層2b、というように導体層と絶縁層とを交互に積層する。また、プリント基板表面の銅箔1a、1cには、通常穴あけ加工前にあらかじめエッチング処理によりレーザ光による穴あけ径（導通穴）より大きめに銅箔部分を

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取り除き、穴601a、601bを設けておく。

【0004】つぎに、以上のように積層したプリント基板に対し、レーザ光を穴601a部分に照射し、導通穴の加工を行う。この加工方法および加工状態を図7に示す。図7に示すように、レーザ光701をレンズ702により穴加工部分703に集光させる。このとき、レーザ光のパワー強度およびスポット径により絶縁層2aが取り除かれる。つまり、絶縁層2aは、レーザ光の熱エネルギーにより瞬時に蒸発する。この結果、図示の如く穴704aが形成される。また、同様の方法で、穴704cを形成する。

【0005】ところで、プリント基板の穴あけ加工に関する参考技術文献として以下のものが開示されている。たとえば特開昭56－144890号公報・特開昭58－218387号公報においては、加工部に低沸点の物質を配し、該物質にレーザ光が照射され、爆発的に蒸発するガスを利用し、加工時に生じる不要物を排除することが開示されている。また、特開平3－171610号公報においては、レーザ光が照射されると蒸発（昇華）する材料として亜鉛を使用することが開示されている。さらに、特開平6－335790号公報には、積層基板の導電材料として銅箔を使用することが開示されている。

【0006】

【発明が解決しようとする課題】しかしながら、上記に示されるような従来の技術にあっては、銅箔1bが薄い層であるものの、熱伝導性が高いのでレーザ加工時に熱が逃げ、加工が十分に行われずに残渣層705a、705bが穴底部分に残ってしまう。この残渣層705a、705bは絶縁層であるので、別の加工工程により除去する必要が生じ、生産性の向上を阻害するという問題点があった。

【0007】さらに付言すれば、図8に示すように、銅箔1b（18μm程度）は絶縁層2a（20～30μm）に対してレーザ光照射で穴あけ加工を行った結果、1～2μmの厚さの残渣層705aが残り、このままの状態で化学メッキ等により導体801を形成しても、残渣層705aが穴底面に存在しているので、銅箔1aと銅箔1bとを導通させることができないという問題点もあった。

【0008】この発明は、上記に鑑みてなされたものであって、複数層のプリント基板に導通穴を明ける際に、残渣が残らないプリント基板およびその加工方法を提供することにより、プリント基板における導通穴加工の生産性を向上させ、かつ、導通性向上による高信頼性を実現するプリント基板およびそのレーザ穴あけ方法を得ることを目的とする。

【0009】

【課題を解決するための手段】上記の目的を達成するために、この発明に係るプリント基板にあっては、導体層

と絶縁層とを交互に積層し、前記導体層に回路パターンを形成するプリント基板において、層間を導通させる導通穴を加工する側の中間の導体層表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成するものである。

【００１０】すなわち、導通穴を加工する側の中間の導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成することにより、レーザ光を照射して極微細な穴を加工する際に、絶縁層が瞬時に蒸発すると共に、その絶縁層と導体層との間に設けた上記特性を有する金属層の表面が蒸発し、穴底部分の残渣を完全に取り除くことが可能となプリント基板を提供することができる。

【００１１】つぎの発明に係るプリント基板にあっては、前記低熱伝導で、かつ、低沸点の特性を有する金属層は、亜鉛とするものである。

【００１２】すなわち、層間を導通させる導通穴を加工する側の中間の導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する亜鉛を用いることにより、レーザ光を照射して極微細な穴を加工する際に、絶縁層が瞬時に蒸発すると共に、その絶縁層と導体層との間に設けた上記特性を有する金属層の表面が蒸発し、穴底部分の残渣を完全に取り除くことが可能となる。

【００１３】つぎの発明に係るプリント基板のレーザ穴あけ方法にあっては、導体層と絶縁層とを交互に積層し、導体層に回路パターンを形成したプリント基板に対し、レーザ光を焦点位置近傍でスポット照射し、前記プリント基板の中間の導体層との間の絶縁層に極微細穴を明けるプリント基板のレーザ穴あけ方法において、前記導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成する第１の工程と、前記金属層表面を蒸発させるのに必要な熱エネルギーを有するレーザ光をスポット照射し、前記絶縁層を取り除く第２の工程と、を含むものである。

【００１４】すなわち、導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成し、金属層表面を蒸発させるのに必要なエネルギーを有するレーザ光をスポット照射して絶縁層を取り除くことにより、穴底部分の金属層表面がある程度蒸発し、従来より底の部分に生じやすかった残渣を完全に取り除くことが可能となる。

【００１５】つぎの発明に係るプリント基板のレーザ穴あけ方法にあっては、前記低熱伝導で、かつ、低沸点の特性を有する金属層は、亜鉛とするものである。

【００１６】すなわち、層間を導通させる導通穴を加工する側の中間の導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する亜鉛を用いることにより、レーザ光を照射して極微細な穴を加工する際に、絶縁層が瞬時に蒸発すると共に、その絶縁層と導体層との間に設けた上記特性を有する金属層の表面が蒸発し、穴底部分の残渣

を完全に取り除くことの可能な加工方法が実現する。

【００１７】

【発明の実施の形態】以下、この発明に係るプリント基板およびそのレーザ穴あけ方法の実施の形態について添付図面を参照し、詳細に説明する。なお、この実施の形態の各図において、従来例と同一機能要素については従来の技術で用いた符号と同一の符号を付して、その説明を省略する。

【００１８】図１は、実施の形態に係るプリント基板の積層構造を示す断面図である。このプリント基板１０２は、前述した従来例の図６に示したプリント基板に対し、中間導体層としての銅箔１ｂの上下面に、それぞれ低熱伝導・低沸点の特性を有する亜鉛メッキ１０１ａ、１０１ｂの金属層を形成したものである。つまり、絶縁層２ａ、２ｂに挟まれた導体層である銅箔１ｂの両面に亜鉛メッキ１０１ａ、１０１ｂを施し、金属層を形成する。なお、この例では銅箔１ｂの両面に亜鉛メッキ１０１ａ、１０１ｂを施したが、必要に応じて、つまり穴あけ側に対応して亜鉛メッキすればよいので、これに限らない。

【００１９】亜鉛メッキ１０１ａ、１０１ｂに使用する亜鉛は、良導体であると共に、特に熱伝導率が９７ｋｃａｌ／ｍｈ°Ｃ、沸点が９０６°Ｃの特性を有し、金属の中では熱伝導が低く、かつ、沸点の低い代表的な金属である。また、銅箔１ｂに使用する銅は、熱伝導率が３３２ｋｃａｌ／ｍｈ°Ｃ、沸点が２６００°Ｃの特性を有している。この両者の熱伝導率および沸点を比較すると、亜鉛の熱伝導率は銅に対して約１／３、沸点も約１／３である。

【００２０】したがって、亜鉛を溶かすのに適切なパワー（熱エネルギー）のレーザ光を亜鉛に照射すると、その表面が蒸発して照射部分のみを除去することが可能になる。つまり、プリント基板１０２のスルーホールを設ける側の中間導体層（銅箔１ｂ）表面に、低熱伝導・低沸点の金属層（亜鉛）をメッキによって形成することで、レーザ光照射による穴あけ加工時に亜鉛を蒸発させ、絶縁層の残渣が残るという不具合を解消させることが可能となる。

【００２１】つぎに、上記図１の如く積層されたプリント基板１０２にバイヤホール（スルーホール）を設けるための穴あけ加工例について説明する。

【００２２】図２は、実施の形態に係る穴あけ加工状態を示す説明図である。ここでは、レンズ７０２の焦点位置近傍にプリント基板１０２をセットし、レーザ光７０１をレンズ７０２により集光し、穴あけ加工を行った場合を示している。

【００２３】プリント基板１０２表面の銅箔１ａは、穴あけ加工される部分があらかじめエッチングなどにより取り除かれている。この状態でレーザ光を絶縁層２ａにスポット照射すると、絶縁層２ａはエポキシ樹脂あるい

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はポリイミド樹脂であるので瞬時に溶融・蒸発し、図2に示すようなガス103となって外側に放出され、その部分が穴となる。このとき、亜鉛メッキ101aは、導体層である銅箔1bに近い側は蒸発しないが、レーザ光が照射された側は表面がガス103となって外部に放出される。同時に、従来において発生していた残渣が一時的には亜鉛の表面に生じるが、穴の底面104は亜鉛の蒸発によって飛ばされ、完全に除去される。

【0024】したがって、プリント基板102の穴あけ（バイヤホール）は、亜鉛メッキ101の表面が蒸発し、少し凹んだ状態で加工される。亜鉛メッキ101に用いた亜鉛は、良導体であるので、この穴の底面104は銅箔1bに対して十分低い電気抵抗で導通する。

【0025】図3は、図2における穴加工例を示す拡大図であり、（a）は穴加工直後の詳細な状態を拡大した断面図、（b）は穴部分への後処理後の状態を拡大した断面図である。先にも述べたように、図1の如く積層したプリント基板102に所定のレーザ光照射すると、図3（a）に示すような穴が形成される。この穴の底面104は残渣層が完全に除去されて表面が蒸発し、亜鉛メッキ101aの層表面が少し凹んだ状態で加工される。

【0026】図3（a）の穴加工を行った後、銅箔1aと亜鉛メッキ101aの穴部分に化学メッキ等により導体801を形成する。これにより導体層である銅箔1aと銅箔1bとを亜鉛メッキ101aを介して完全に導通させることができる。

【0027】つぎに、前述と同様の手順に基づいて導体層／亜鉛メッキ・中間導体層／絶縁層を積層した多層のプリント基板を形成し、そのプリント基板にバイヤホールを形成する例について説明する。

【0028】図4は、実施の形態に係る多層プリント基板のバイヤホール形成例（1）を示す断面図である。図4に示すように、まず、プリント基板として、第1の導体層である導体層1aの下部層に絶縁層2a、絶縁層2aと第2の導体層である銅箔1bの間に亜鉛メッキ101aを積層し、導体層1bの下部層に絶縁層2b、絶縁層2bと第3の導体層である銅箔1cの間に亜鉛メッキ101cを積層し、絶縁層2cと第4の導体層である銅箔1dの間に亜鉛メッキ101dを積層する。なお、絶縁層2aは、ガラス繊維強化エポキシ樹脂層（ガラエポ層）あるいはポリイミド層で構成される。

【0029】つぎに、たとえば銅箔1aと銅箔1cとを導通する穴401を形成する場合、前述と同様に、第2の層の亜鉛メッキ101cの表面までレーザ光をスポット照射し、穴加工を行う。また、銅箔1aと銅箔1dとを導通する穴402を形成する場合も同様に、第3の層の亜鉛メッキ101dの表面までレーザ光をスポット照射し、穴加工を行う。その後、各穴401、402に対し、銅箔1aと亜鉛メッキ101cの表面部分、および銅箔1aと亜鉛メッキ101dの表面部分に化学メッキ

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等により導体801を形成し、完全に導通させる。

【0030】図5は、実施の形態に係る多層プリント基板のバイヤホール形成例（2）を示す断面図であり、第2の層と第3の層とを1つのバイヤホールで3層同時にスルーホールを形成する例について示している。まず、第1の導体層～第4の導体層からなるプリント基板を図4と同様に形成する。その後、通常、絶縁層2aに大きめの穴を明け、2回目に、絶縁層2bに対し、絶縁層2aの穴加工時よりさらにレーザ光のビーム径を絞って光照射することにより、第3の導体層である銅箔1c表面部分まで穴あけを行う。さらに、穴あけ部分の導通を完全にするために、銅箔1a端部から亜鉛メッキ101c表面部分に化学メッキ等により導体801を形成する。これにより穴（バイヤホール）501が得られる。

【0031】また、上記の穴あけ加工方法に代わる他の方法として、第1の導体層目より第2の導体層目の銅箔1bの穴を小さくしておき、1回のレーザ光照射でバイヤホールを形成してもよい。この方法を用いることにより、多層のプリント基板の同時穴あけが1層の場合と同様に行うことが可能となり、加工性が向上し、かつ、加工時間を短縮することができる。さらに、複数層の銅箔の穴を下層になるに従って小さくしておき、その複数層を1回のレーザ光照射により、容易に穴あけを行うことも可能である。

【0032】ここで、以上述べてきたこの発明の実施の形態を総括する。プリント基板にレーザ光を照射し、穴加工を行う場合、まず、レーザ光照射側の導体層である銅箔の表面の低熱伝導で、かつ、低沸点の金属である亜鉛をメッキにより形成し、そこに所定のパワー強度・スポット径のレーザ光を照射する。このレーザ照射により亜鉛自体がその低熱伝導・低沸点であるために蒸発し、絶縁層の残渣を吹き飛ばすので残渣が穴の底に残ることがなくなる。

【0033】また、亜鉛は良導体の特性を有するので、導体層である銅箔と完全な導通をとることができる。従って、レーザ光照射により穴あけした後に、残渣層を除去するという従来において面倒な加工工程が不必要となるので、加工効率が向上すると共に、導通性が確保されるので信頼性の高いバイヤホール（スルーホール）を形成することができるといった優れた効果が得られる。

【0034】

【発明の効果】以上説明したように、この発明に係るプリント基板によれば、導通穴を加工する側の中間の導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成することにより、つぎの導通穴を加工する工程において、レーザ光を照射して極微細な穴を加工する際に、絶縁層が瞬時に蒸発すると共に、その絶縁層と導体層との間に設けた上記特性を有する金属層の表面が蒸発し、穴底部分の残渣を完全に取り除くことができるため、残渣を除去するための別工程が不要となって生産

性が向上し、かつ、残渣のない金属層が中間の導体層に完全に導通しているので良好な導通性が得られ、信頼性が向上する。

【００３５】つぎの発明に係るプリント基板によれば、層間を導通させる導通穴を加工する側の中間の導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する亜鉛を用いることにより、レーザ光を照射して極微細な穴を加工する際に、絶縁層が瞬時に蒸発すると共に、その絶縁層と導体層との間に設けた上記特性を有する金属層の表面が蒸発し、穴底部分の残渣を完全に取り除くことができる。

【００３６】つぎの発明に係るプリント基板のレーザ穴あけ方法によれば、導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する金属層を形成し、金属層表面を蒸発させるのに必要なエネルギーを有するレーザ光をスポット照射して絶縁層を取り除くことにより、穴底部分の金属層表面がある程度蒸発し、従来より底の部分に生じやすかった残渣を完全に取り除くことができるため、残渣を除去するための別工程が不要となって生産性が向上し、かつ、残渣のない金属層が中間の導体層に完全に導通しているので良好な導通性が得られ、信頼性が向上する。

【００３７】つぎの発明に係るプリント基板のレーザ穴あけ方法によれば、層間を導通させる導通穴を加工する側の中間の導体層の表面に、低熱伝導で、かつ、低沸点の特性を有する亜鉛を用いることにより、レーザ光を照射して極微細な穴を加工する際に、絶縁層が瞬時に蒸発すると共に、その絶縁層と導体層との間に設けた上記特性を有する金属層の表面が蒸発し、穴底部分の残渣を完全に取り除くことの可能な加工方法が実現する。

【図面の簡単な説明】

【図１】　この発明の実施の形態に係るプリント基板の積層構造を示す断面図である。

【図２】　この発明の実施の形態に係る穴あけ加工状態を示す説明図である。

【図３】　図２における穴加工例を示す拡大図であり、（ａ）は穴加工直後の詳細な状態を拡大した断面図、（ｂ）は穴部分への導体処理後の状態を拡大した断面図である。

【図４】　この発明の実施の形態に係る多層プリント基板のバイヤホール形成例（１）を示す断面図である。

【図５】　この発明の実施の形態に係る多層プリント基板のバイヤホール形成例（２）を示す断面図である。

【図６】　従来におけるプリント基板の積層構造を示す断面図である。

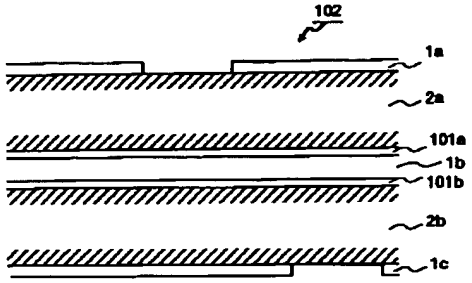
【図７】　従来における穴あけ加工状態を示す説明図である。

【図８】　従来における穴あけ加工後の導体形成状態を示す断面図である。

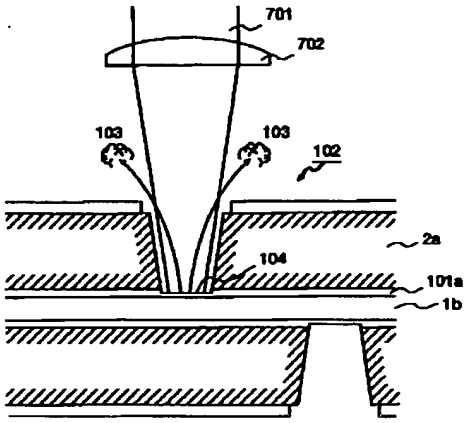
【符号の説明】

１ａ，１ｂ，１ｃ，１ｄ　銅箔，２ａ，２ｂ，２ｃ　絶縁層，１０１ａ，１０１ｂ，１０１ｃ，１０１ｄ　亜鉛メッキ，１０２　プリント基板，７０２　レーザ光。

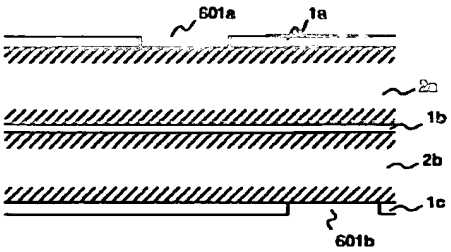
【図1】



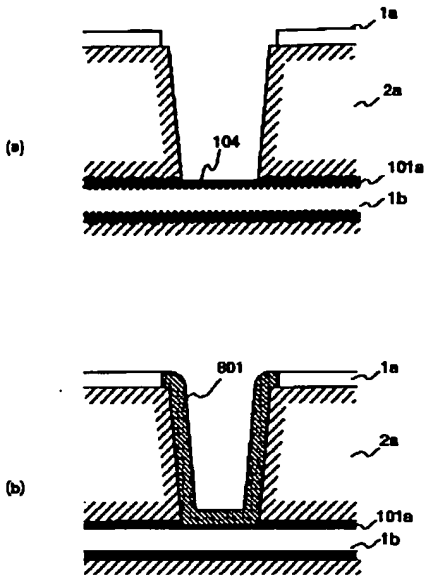
【図2】



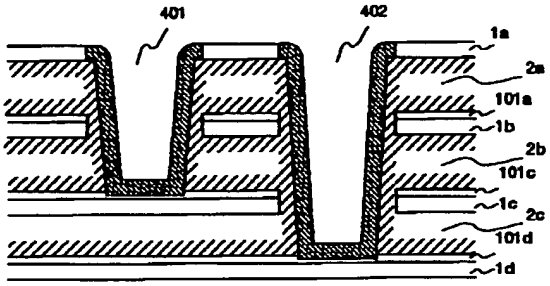
【図6】



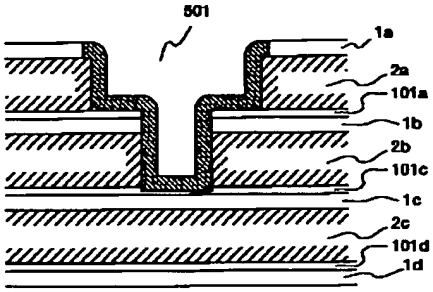
【図3】


(a)
1a
2a
104
101a
1b
(b)
801
1a
2a
101a
1b

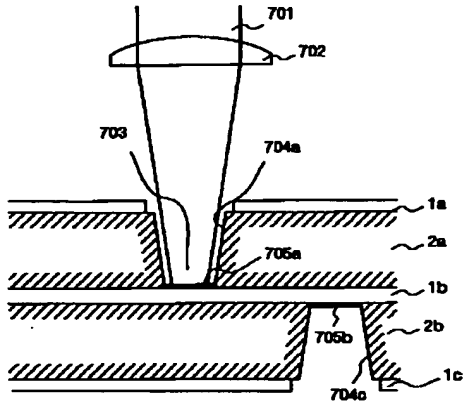
【図4】


401
402
1a
2a
101a
1b
2b
101c
1c
2c
101d
1d

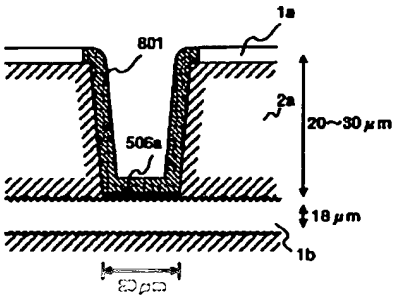
【図5】


501
1a
2a
101a
1b
2b
101c
1c
2c
101d
1d

【図7】


701
702
703
704a
1a
2a
705a
1b
705b
2b
704c
1c

【図8】


1a
801
2a
20~30μm
506a
18μm
1b
30μm

フロントページの続き

(51)Int.Cl.[6]	識別記号	FI		
H05K 3/46		H05K	3/46	X
// H05K 3/24			3/24	A

DERWENT-ACC-NO: 1999-450459

DERWENT-WEEK: 200122

TITLE: Laminated structure of multilayered printed circuit board - has zinc plating formed on surface of copper laminate, arranged between insulating layers

PATENT-ASSIGNEE: MITSUBISHI ELECTRIC CORP[MITQ]

PRIORITY-DATA: 1997JP-0356839 (December 25, 1997)

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		006		B23K 026/00

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ABSTRACTED-PUB-NO: JP 11186678A

BASIC-ABSTRACT:

NOVELTY - The printed circuit board comprises a copper laminates (1a-1c) and
insulating layers (2a,2b) laminated alternately. Zinc plating layers
(101a,101b) with low thermal conductivity and boiling point are formed on both
surfaces of the middle copper laminate (1b).

USE - In multilayered printed circuit board.

ADVANTAGE - As the middle copper laminated is provided with zinc plating,
favorable conduction property and improved reliability are achieved during
laser drilling process. DESCRIPTION OF DRAWING(S) - The diagram shows the
sectional view of laminated structure of multilayered printed circuit board.
(1a-1c) Copper laminates; (2a,2b) Insulating layers; (101a,101b) Zinc plating
layers.

CHOSEN-DRAWING: Dwg.1/8

TITLE-TERMS: LAMINATE STRUCTURE MULTILAYER PRINT CIRCUIT BOARD ZINC PLATE
FORMING SURFACE COPPER LAMINATE ARRANGE INSULATE LAYER

DERWENT-CLASS: P55 V04

EPI-CODES: V04-Q01; V04-R02; V04-R03A; V04-R05A; V04-R07P;

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